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PHYSICAL CHEMISTRY.—*Further experiments on the volatilization of platinum.*[1] G. K. BURGESS and R. G. WALTENBERG, Bureau of Standards.

This is a continuation of an investigation[2] undertaken at the suggestion of the Committee on "Quality of Platinum Utensils" of the American Chemical Society. Seven platinum crucibles of various makes and purity have been subjected to successive heatings at 700, 1000, and 1200°C. followed by determination of iron and other materials soluble in 1:4 boiling hydrochloric acid. Among the results obtained are the following:

1. Platinum ware in the form of crucibles of whatever degree of purity behaves, with respect to gain or loss of weight on heating in air at ordinary atmospheric pressure, in a manner characteristic only of the temperature of heating.

2. Each impurity, as iridium, rhodium, or iron, appears to exert its effect on the volatilization of platinum independently.

3. For platinum crucibles of all degrees of purity containing Ir, Rh, Fe, Si (up to a content of at least 3.0 per cent Ir) the loss on heating is negligible below about 900°C.

4. Below this temperature there may even be a slight gain in weight on heating platinum, owing to the iron content diffusing to the surface and oxidizing. At higher temperatures the

[1] To appear in detail as Bureau of Standards Scientific Paper No. 280 (Bull. Bur. Stds., **13**: 365 et seq.). 1916.

[2] Bureau of Standards Scientific Paper No. 254 (Bull. Bur. Stds., **26**: 289–316. 1915). This JOURNAL, **5**: 378–380. 1915.

presence of iron will lower the volatilization loss by amounts depending on the quantity of iron present. There appears to be no platinum made which does not contain some iron.

5. The volatilization of platinum containing rhodium is less than that of pure platinum at all temperatures above 900°C.

6. The volatilization of platinum containing iridium is, above 900°C., very much greater than that of pure platinum, and increases with the Ir content and with temperature.

7. It appears to make no material difference in the volatilization results, in the range 700° to 1200°, what is the order of heating, ascending or descending temperatures.

8. In an oxidizing atmosphere at temperatures of the order of 1000°C., platinum, in the presence of but not in contact with silica, will apparently take up small quantities of this substance.

9. The loss in crucible weight due to the solution of soluble matter in HCl, after heating, is variable depending on the crucible and may be large. This loss in relatively greater at low than at high temperatures.

10. All of the above losses, caused by heating, acid treatment, and iron diffusion, apparently continue with undiminished magnitude after the first treatment, which is usually erratic.

11. The following table gives the approximate changes in weight to be expected for heating platinum containing iridium or rhodium but nearly free from iron. The presence of iron in appreciable quantities renders the prediction uncertain but it always acts in the direction of lowering the volatilization loss. Silica, if taken up from the furnace, will also tend to lower the results slightly.

Approximate loss in milligrams per hour per 100 square centimeters at temperatures indicated. Platinum nearly free from iron

TEMPERATURE	PLATINUM CONTAINING			
Degrees C.	Pure Pt	1 per cent Ir	2.5 per cent Ir	8 per cent Rh
900 or less	0	0	0	0
1000	0.08	0.30	0.57	0.07
1200	0.81	1.2	2.5	0.54

PETROLOGY.—*Note on the lithophysae in a specimen of obsidian from California.* F. E. WRIGHT, Geophysical Laboratory.

In a specimen of obsidian[1] from Little Lake, about 40 miles south of Owen's Lake, Inyo County, California lithophysae occur which resemble the lithophysae of the obsidian from Hrafntinnuhryggur, Iceland[2] and are of interest because of their bearing on the general theory of the formation of hollow spherulites. Two hypotheses have been proposed to explain the development of lithophysae: (a) the total effect is ascribed to hydrostatic tension or uniform pull resulting from the contraction of the magma during cooling; (b) emphasis is placed on the outward pressure of the gases set free during the crystallization of the spherulites. These two hypotheses are not mutually exclusive and probably both factors, shrinkage of the cooling magma and pressure of gas liberated on crystallization, play an important rôle in the development of most lithophysae. In the case of the Icelandic lithophysae it has been shown that gas pressure was probably the more important of the two factors; similarly in the present specimen from California the evidence presented below indicates that gas pressure rather than hydrostatic tension was the effective agent.

The obsidian. The specimen as a whole is jet black in color and of the characteristic vitreous aspect and conchoidal fracture of obsidian; thin splinters are relatively clear and transparent. The refractive index of the glass is low ($n = 1.484$) and indicates high silica content. Small microlites of a lath shaped mineral showing approximately parallel extinction and negative, rarely positive, elongation are scattered through the glass. The mineral is probably soda-potash feldspar. Minute particles of magnetite are abundant. The total amount of crystallized material is less than 2 per cent. The specific gravity is 2.353.

[1] Collected by Mr. Chas. R. Fletcher of Los Angeles, Cal., and sent by him for examination to Mr. F. L. Ransome, U. S. Geological Survey, who, in turn, presented it to the writer for study. The specimen is now deposited in the U. S. National Museum. Spec. No. 88922.

[2] F. E. Wright. Obsidian from Hrafntinnuhyrggur, Iceland: Its lithophysae and surface markings. Bull. Geol. Soc. America, **26**: 255–286. 1915.

The spherulites and lithophysae. All the larger spherulites are hollow and are lined with minerals similar to those contained in the lithophysae of obsidian from other localities. The predominating mineral crystallizes in fibers arranged radially, is weakly birefracting, extinguishes parallel with positive or negative elongation, and has refractive indices: $\alpha > 1.520$, $\gamma < 1.530$. Some of the sections extinguish in a manner indicative of submicroscopic twinning. These properties agree with those of a potash-soda feldspar. The size of the fibers is not uniform; near the outer wall of the spherulite the individual fibers are exceedingly fine but toward the center they increase in size, become clearer and are there associated with a second, more transparent mineral, tridymite, which appears in characteristic, small nodules and clusters, studding the cavity walls. Under the microscope the tridymite aggregates are weakly birefracting, and have an average refractive index slightly less than 1.480. Minute octahedra and irregular grains of magnetite are disseminated throughout the crystalline mass of each spherulite. These grains increase also noticeably in size from the wall toward the center of the cavity.

In addition to the above predominating minerals well developed, tabular crystals of brown transparent fayalite were observed in some of the cavities. They are identical in optical properties, so far as determined, with the Icelandic and Yellowstone Park lithophysal fayalite. In several of the cavities single, small crystals of a jet black mica of uncommonly high refractive index, apparently slightly above 1.70, were noted. The optic axial angle is small (2E less than 50°); the dispersion of the optic axes is noticeable. This mica is interesting because its presence, as a water-bearing mineral, proves that water vapor was among the gases in the lithophysal cavity.

This mineral association and the pronounced increase in granularity from the margin to the center of a cavity prove that during the crystallization of the spherulite chemically active volatile components were present and attacked part of the material of

the spherulites; new crystal compounds, such as tridymite and fayalite, were formed which are absent in the solid spherulites and in ordinary rhyolites, and indicate physico-chemical conditions of formation different from those which ordinarily obtain during the crystallization of a silicate magma. The pressure of the liberated volatile components aided effectively in the original formation and subsequent enlargement of the lithophysal cavities; this is evident both from the shape of the outer walls of the cavity whose radius of curvature is not constant and whose thickness varies inversely with the radius of curvature, and also from the fact that segments of the radial spherulite were forced apart as crystallization proceeded. All these phenomena were observed in the Icelandic lithophysae; and the conclusions there drawn are corroborated in detail by the present specimen, although here the lithophysae are less symmetrical and the mechanism of the enlargement of the cavities is less difficult to understand.

Additional evidence in support of the gas pressure hypothesis is presented by three parallel bands or planes which traverse the specimen and probably represent contact planes between portions of the thick viscous lava which flowed together; flow lines occur in the obsidian parallel to these planes, which are now marked by the crystallization of minute, chiefly solid, radial spherulites. The fact that relatively few of the lithophysae are elongated parallel to these flow planes proves that the cavities are not original vesicles, from which crystallization subsequently spread in the later stages of the flow; the directions of expansion of the cavities bear, moveover, no relation to the structural planes in the obsidian as they should do, were the lithophysal cavities the result solely of contraction of the magma on cooling. In this occurrence, therefore, the evidence is in favor of the hypothesis that in the formation of the lithophysal cavities volatile gases set free during the crystallization of the spherulites were the active factor, and not a secondary phenomenon accompanying the opening of the cavities by hydrostatic tension.

BOTANY.—*Proposed classification of the genus Rollinia, with descriptions of several new species.* W. E. SAFFORD, Bureau of Plant Industry.

Among the finest fruits of tropical America are certain custard apples of the genus Rollinia. This genus, belonging to the Annonaceae, is characterized by fruits closely resembling the chirimoya (*Annona cherimola* Miller), the sugar-apple or *pomme-cannelle* (*A. squamosa* L.), and the bullock's heart (*A. reticulata* L.), but its flowers are very distinct in form from those of the genus Annona.

Much confusion exists in the botanical classification of the principal commercial species of this genus. This is owing chiefly to the fact that, in original descriptions, either the fruit and not the flower was described, or vice versa, and that botanical names have been applied to fruits in the markets unaccompanied by leaves or flowers, which are necessary to determine the species. As a result, Martius, in his great work, *Flora Brasiliensis*, applies the name *Annona obtusiflora* to a Rollinia sold in the markets of Brazil under the name *fructa do Conde*, which he imagined to have been introduced into Brazil from the Antilles; and a second species of Rollinia, mentioned by Marcgrave under the name *biribá*, he places in the genus Duguetia under the name *D. Marcgraviana*. The only large-fruited Brazilian Rollinia which he mentions under its true generic name he refers to Alphonse De Candolle's *R. orthopetala*, a species of British Guiana, the fruit of which was not seen by De Candolle.

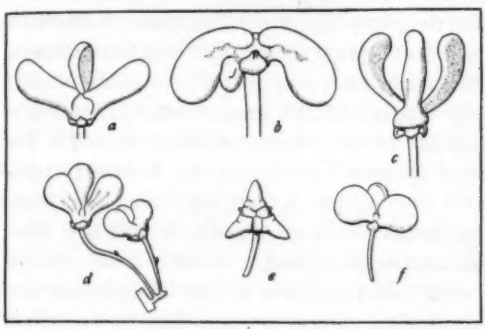

Fig. 1. Types of Rollinia flowers: *a*, *R. Sieberi*; *b*, *R. deliciosa*; *c*, *R. laurifolia*; *d*. *R. rugulosa*; *e*, *R. lanceolata*; *f*, *R. emarginata*.

An examination of herbarium material and of fruits of several species introduced into Florida by the Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, shows that certain longstanding errors should be corrected and that the genus needs revision.

It may be well to point out, in connection with the plants above mentioned, that *Annona obtusiflora* was described by De Tussac in 1808 from a cultivated plant growing in an orchard near the western extremity of Haiti, and was regarded by Baillon as a synonym of *Rollinia mucosa*, a species based on Jacquin's *Annona mucosa* growing wild and in cultivation on the island of Martinique. The *biribá*, which Corrêa, in his recent *Flora do Brazil*, identifies with Martius's *Duguetia Marcgraviana*, must be a Rollinia; it cannot possibly belong to the genus Duguetia, since its fruit does not, as in Duguetia, consist of separate carpels borne on the indurated receptacle, but is an edible syncarpium with fleshy pulp from which a fermented drink is sometimes made.[1] The only Brazilian species of Rollinia introduced into Florida under the name *Rollinia orthopetala* which has yielded a large edible fruit cannot possibly be the true *R. orthopetala* A. DC., since its flowers are not like the flowers of that species, but have their outer corolla lobes broadly spreading and curving downward, instead of "erect and incurved," as described by De Candolle. Corrêa, in the work cited, refers the *biribá* of Pernambuco and Matto Grosso to *Duguetia Marcgraviana* Mart. and the *biribá* of Pará to *Rollinia orthopetala* A. DC.

FLOWERS OF ROLLINIA

The flowers of Rollinia differ from those of Annona in having a gamopetalous corolla composed of three large outer lobes and three minute inner lobes alternating with them. The large lobes, corresponding to the outer petals of Annona, are produced into wings or spurs, the form of which differs so widely that they offer a convenient basis for classification. In the accompanying illustration (fig. 1) the principal types of Rollinia flowers are

[1] "Os fructos são comestiveis e submettidos á fermentação ,dão bebida vinosa." —M. Pio Corrêa. Flora do Brazil, p. 22. 1909.

shown. The outer corolla lobes may be: (a) compressed, widely spreading, and more or less ascending or upcurved, as in *Rollinia mucosa* (Jacq.) Baill.; (b) decurved and obtuse or rounded at the extremity, as in *Rollinia deliciosa* and *R. Pittieri*, to be described below; (c) erect or ascending and incurved, as in *Rollinia orthopetala* A. DC. and *R. laurifolia* Schlecht.; (d) obovate and ascending, as in *Rollinia rugulosa* Schlecht.; (e) short, thick, and spur-like, as in *Rollinia lanceolata* R. E. Fries; or (f) suborbicular or broadly obovate and widely spreading, as in *Rollinia emarginata* Schlecht.

FRUITS OF ROLLINIA

In the genus Rollinia the fruit is a fleshy syncarpium, composed of a number of one-seeded carpels which become fused into a solid spheroid or ovoid head. In some cases the surface of the fruit is distinctly areolate, as in *R. mucosa*, the areoles being marked by pentagonal or hexagonal outlines and bearing mamillate projections. These may point outward, or be recurved toward the stem, or curved toward the apex of the fruit; or the areoles may be gibbous or rounded and very distinct, like those of the sugar-apple, *Annona squamosa;* or they may terminate in a blunt point. In a few species, as in *Rollinia glaucescens*, the surface of the fruit is nearly smooth, like that of the common *A. reticulata.*

The species in which the mature carpels are quite distinct and fall off separately from the indurated receptacle, or torus, have been set apart by the writer under the generic name Rolliniopsis.[2]

BOTANICAL CLASSIFICATION

The groups suggested above, based upon the form of the flowers, cannot be regarded as subgenera or even as sections, for the line of demarcation is not always sharply drawn. In some species, for example, the corolla lobes may be ascending or nearly erect at first, and at length more widely divergent; while in

[2] Rolliniopsis, a new genus of Annonaceae from Brazil. Journ. Wash. Acad. Sci., **6**: 197. 1916.

others they may be nearly horizontal when immature and at length more or less decurved. Moreover, the members of a group are not always botanically close to one another. Nevertheless the arrangement of the various species into groups according to the shape of the corolla is a great aid to classification and will prevent many errors. A striking example of erroneous identification is that of the flower figured by Baillon and reproduced in Engler and Prantl's *Natürlichen Pflanzenfamilien* under the name *Rollinia mucosa*. This is certainly not the flower of Jacquin's *Annona mucosa*, the *cachiman morveux* of Martinique, which is the type of the species. The slender, ascending, incurved lobes place it at once in the same group with *Rollinia orthopetala* A. DC. and *R. laurifolia* Schlecht. On the other hand, the widely spreading lobes of *Annona obtusiflora*, as figured by De Tussac, place that species in the same group with *Rollinia Pittieri* and *R. deliciosa*, described below. In some cases two or more species with similar leaves and fruits but with very distinct flowers have been wrongly associated under a single name, as in the case of *R. sylvatica*, as usually treated by botanists.

In a systematic study of any group of plants the desirability of going back to the original description of each species will at once be recognized. In certain monographs more easily accessible to the student than the various publications in which the species were first described, amended descriptions are often given, based not on the species itself but upon some allied species mistaken for it. In many cases the monographer has never had the opportunity of examining the type material. Martius, for instance, in describing *Annona obtusiflora* and *Duguetia Marcgraviana* could not possibly have seen the plants on which these species were based; and nothing in De Candolle's description of *Rollinia orthopetala* indicates that the fruit of the plant he described was "of the size of a child's head." The plants growing in the inundated forests along the banks of the Amazon, in the province of Pará, which yielded the fruits described by Martius, may have been specifically distinct from the type of De Candolle's species, which grew near Demerara, in British Guiana, of whose fruit we know nothing but of whose flower we know certainly

that the corolla lobes were erect and incurved. To prevent possible mistakes of this kind the exact locality in which a new species was collected should always be indicated. If this is done incomplete type material may possibly be supplemented by future collections from the same plant or at least from a similar plant growing very near it.

The present writer has not sufficient material to attempt to monograph the genus Rollinia. In the following notes he has been much aided by herbarium specimens from the Botanical Museum of Copenhagen sent him for study through the kindness of Dr. C. H. Ostenfeld.

GROUP A

COROLLA LOBES OBLONG, WIDELY SPREADING AND SLIGHTLY ASCENDING OR UPCURVED

Rollinia dolabripetala (Raddi) St. Hilaire, Fl. Bras. Merid., **1**: 29. 1825.
Annona dolabripetala Raddi, Mem. Soc. Ital. delle Sci. Modena, **18**: 394. 1820.
Rollinia longifolia St. Hil., loc. cit.

In this species, the type of the genus Rollinia, the corolla lobes are laterally compressed and shaped like a hatchet or broad-bladed knife (dolabriform), at first ascending, at length broadly spreading.

TYPE LOCALITY: Mount Corcovado, near Rio de Janeiro, Brazil.

Flowering specimens in the United States National Herbarium were collected in the type locality by Messrs. Rose and Russell (No. 20311).

Rollinia mucosa (Jacq.) Baillon, Adansonia, **8**: 268. 1868.
Annona mucosa Jacq. Obs. 16. 1764 (excl. syn. Rumph.).

The flowers of this species are described as having oblong corolla lobes spreading outward in such a way as "not inaptly to represent a tricorn hat." The areoles of the fruit are gibbous or convex, not papillose or aculeate. The viscous pulp is edible but of poor flavor.

TYPE LOCALITY: Martinique. Growing spontaneously in the forrests and very rarely cultivated; known locally as *cachiman morveux*.

This species is described as resembling in habit *Annona reticulata* L. Specimens in the U. S. National Herbarium, collected by Père Duss in Martinique, have coarser leaves and larger flowers than *Rollinia Sieberi*, and the gibbous areoles of the fruit are bounded by raised polygonal outlines.

Rollinia Sieberi A. DC. Mém. Soc. Phys. Genève, **5**: 200, pl. 2, fig. B. 1832.

This species resembles *R. mucosa*, from which it differs in its smaller flowers, more slender pedicels, and thinner and more delicately veined leaves. De Candolle, who regarded it as specifically distinct from *R. mucosa* (which he mentions), figures the flower as solitary, with laterally compressed corolla lobes, rounded at the extremities and curving slightly upward.

TYPE LOCALITY: Island of Trinidad, British West Indies, where it was collected by Sieber (No. 96) and distributed under the name *Annona reticulata*.

The fruit, according to Père Duss, is usually larger than that of *Annona squamosa*, which it resembles in its raised, squamose areoles and its pleasantly flavored, sweet, fleshy pulp. A specimen in the U. S. National Herbarium collected in Porto Rico by Sintenis (No. 4170) is referred to this species. Urban[3] refers this plant to *R. mucosa* but adds that the Porto Rico specimens have smaller flowers than specimens of *R. mucosa* from other localities. To the writer *R. Sieberi* appears to be a valid species. It is certainly quite distinct from *Annona obtusiflora* De Tussac, of which Baillon believed it a synonym, and also from the Mexican plants referred by Baillon to *R. mucosa*, collected by Liebmann at Mecapulco (No. 27) and Mirador (No. 28), the original specimens of which, with leaves velvety pubescent beneath, are before me. Specimens with flowers and fruit from Trinidad, the type locality of the species, are desired.

GROUP B

COROLLA LOBES OBLONG OR SPATULATE, HORIZONTAL OR CURVED DOWNWARD

Rollinia deliciosa Safford, sp. nov. FIGURE 2.

Rollinia orthopetala Corrêa, Flora do Brazil, p. 22. 1909, not De Candolle.

A medium-sized tree. Blades of the vegetative leaves obovate-oblong or elliptical, rounded or acute at the base, normally acuminate at the apex, 20 to 28 cm. long, 7.5 to 11 cm. broad, membranaceous, when young sparsely canescent-hirtellous above, densely so beneath, especially along the midrib and nerves, at length glabrous above and beneath except along the midrib and primary nerves (18 to 22 on each side), these reddish brown, slender but prominent beneath; petiole about 10 mm. long; blades of the leaves of the flowering branches smaller, the lowermost ones relatively shorter and broader, sometimes broadly

[3] Symb. Antill., **4**: 242.

ovate or orbicular, 3.5 to 6 cm. long, 3.5 to 5 cm. broad. Peduncles leaf-opposed, often in pairs, sometimes solitary, rarely in 3's, 25 to 40 mm. long, bearing a small ovate sessile bracteole near the middle, strigillose with reddish hairs, like the petioles and nerves of the lowermost leaves (prophylla) beneath. Flowers canescent-puberulous; corolla lobes compressed laterally, widely diverging and decurved, rounded at the extremity. Stamens numerous, closely crowded, the expanded connectives forming a pavement above the pollen sacs. Carpels numerous; ovaries hairy; styles expanded, glandular-puberulous. Fruit a solid subglobose syncarpium, 8 to 12 cm. in diameter, the areoles distinctly outlined and terminating in an obtuse beak; peduncle straight and woody, about 5 cm. long; flesh white or cream-colored, juicy, fine-flavored; seeds compressed, 15 to 20 mm. long, 8 to 10 mm. broad, rounded at the apex, gradually narrowing to the base; hilum not prominent; testa thin, brown, wrinkled by the inclosed ruminate endosperm.

Type material in the U. S. National Herbarium, accompanied by photographs of the flowers and fruit, from a tree growing in the Experimental Garden, Miami, Florida, propagated from seed from Pará, Brazil, sent by Mr. C. F. Baker in April, 1908 (No. 22512). Flowering specimen, sheet No. 865973, collected at Miami, Florida, March 11, 1913; fruiting specimen, sheet No. 865976, from the same tree, August 30, 1912; both collected by Edward Simmonds, in charge of the Miami garden.

This plant was introduced into the United States under the name *Rollinia orthopetala*, but it is readily distinguished from that species by the decurved wings of the corolla. Both flowers and fruit were received by the writer from Mr. Simmonds, through the kindness of Mr. P. H. Dorsett, Plant Introducer, Bureau of Plant Industry, in charge of Introduction Field Stations. Mr. C. F. Baker describes its fruit, known in Brazil as the "*biribá* of Pará," as the finest annonaceous fruit of Tropical America. The accompanying illustration (fig. 2) is from a drawing of type material by Mrs. R. E. Gamble.

Rollinia Pittieri Safford, sp. nov.

A forest tree with leaves glaucous beneath and abruptly acuminate. Blades of the vegetative leaves elliptical or obovate, 16 to 20 cm. long, 7 to 8.5 cm. broad, the midrib and primary nerves (16 to 20 on each side) reddish brown beneath; leaves of flowering branches smaller, with 10 to 12 pairs of lateral nerves. Pedicels in clusters of 3 or 4, straight or curved, graduated in length, the longer ones 35 to 50 mm. long, minutely rufous-puberulent, bracteolate near the middle. Flowers minutely puberulent, as though composed of felt; calyx and spheroid base of the corolla rufous; calyx lobes triangular, acute or acuminate, appressed to the corolla, the tips reflexed; corolla wings 15 to 20 mm. long, 6 to 10 mm. broad near the extremity, laterally compressed,

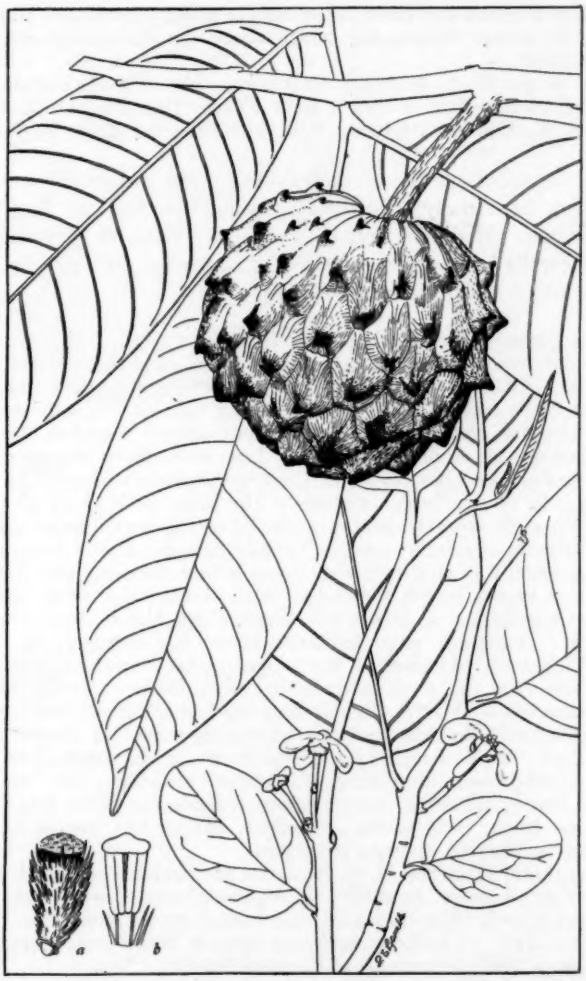

Fig. 2. *Rollinia deliciosa* Safford. From the type material. Branches with leaves, flowers, and fruit, one-half natural size; *a*, carpel, and *b*, stamen, much enlarged.

falcate, horizontally spreading and curved downward, rounded at the apex, narrowed at the base; inner corolla lobes very small, triangular, connivent, almost closing the orifice above the essential parts. Fruit not observed.

Type in the U. S. National Herbarium, No. 679511, collected near sea level, on the plain of Sperdi, near Puerto Obaldía, San Blas Coast, Panama, September, 1911, by Henry Pittier (No. 4358, in flower.)

This beautiful species is remarkable for the pale under surface of its leaves, beautifully veined with reddish brown, and its clustered inflorescence. It differs from *R. rufinervis* Triana & Planch. in having the corolla lobes curving downward instead of divergent-ascending. Specimens of the fruit are desired.

Rollinia Jimenezii Safford, sp. nov. FIGURE 3.

A small tree of Costa Rica, resembling *R. mucosa*, but the flowers in clusters of 2 or 3, the corolla wings horizontally spreading and slightly decurved, the fruit when fresh resembling that of the common sugar-apple (*Annona squamosa*), its component carpels rounded at the tips but when dry more or less beaked. Leaves ovate to oblong-elliptical, acuminate at the apex, those of the vegetative branches 18 to 30 cm. long, 6.5 to 14 cm. broad, obtuse at the base, with 18 to 22 primary nerves on each side, the leaves of the flowering branches smaller, with 12 to 16 pairs of primary nerves, usually rounded at the base; point of acumen usually obtuse or retuse; young branches, petioles, and lower surface of young leaves pubescent with ferruginous hairs, the leaves at length glabrous or nearly so except along the midrib and nerves beneath. Peduncles extra-axillary, often leaf-opposed, in clusters of 2 or 3, graduated in length, the longest about 2 cm. long, ferruginous-tomentose like the ovate-acuminate calyx lobes. Corolla lobes oblong, rounded at the tip, slightly narrowed at the base, widely spreading and usually decurved, never curving upward and inward, rufous-puberulent. Fruit subglobose, about 6 cm. in diameter, 6 to 10 cm. long, closely resembling that of *Annona squamosa*, the component carpels loosely adhering, very gibbous, rounded or often retuse at the tip when fresh; pulp white, acidulous, edible, but not so agreeably flavored as that of *Annona squamosa*.

Type material in the U. S. National Herbarium, collected by Otón Jiménez at Nuestro Amo, Province of Alajuela, Costa Rica; flowers collected March, 1912, (No. 427), and fruit from the same tree, October, 1912 (No. 543). The accompanying figure is drawn from type material and from a field photograph of the fresh fruit.

The author takes great pleasure in naming this species in honor of Mr. Otón Jiménez, of San José, Costa Rica, an accomplished young botanist to whom he is indebted for herbarium specimens of the plant,

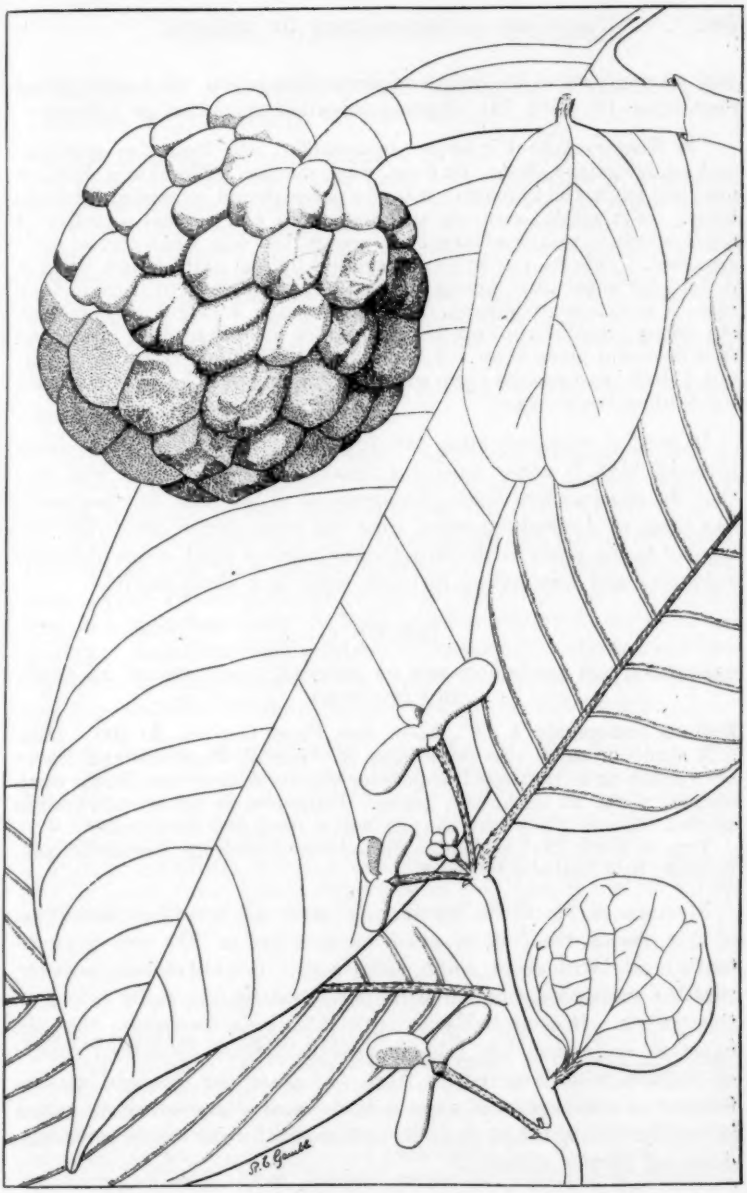

Fig. 3. *Rollinia Jimenezii* Safford. From the type material. Natural size.

field photographs of the fruit, and descriptive notes. In a letter dated September 12, 1912, Mr. Jiménez describes the plant as follows:

"At Nuestro Amo it is known as *anonillo*. The fruits are squamose and are sometimes 10 cm. by 6 cm. when mature. The skin is then yellow; but while still immature it is of a greenish and somewhat glaucous color. It is edible, with an acidulous pulp and a great quantity of seeds which have a tendency to adhere to the skin when the latter is removed. This fruit is little appreciated by the natives, but when it is kept for some time among the leaves and allowed to become fully ripe, it is rather appetizing. The trees reach a height of 8 meters. On young [vegetative] branches the leaves are often quite large, and of a beautiful green color. I hope to obtain for you fruits fully ripe, but I shall have to send them to you in fragments as I have no facility for sending them entire."

In another communication Mr. Jiménez states that all the Rollinia material from Nuestro Amo was obtained from the same tree, and that the specimens of fruits photographed in the field, so remarkably like those of *Annona squamosa*, were the same as the dried fruit forwarded to the writer, with the individual carpels much more distinctly separated and terminating in many cases in a sharp point.

GROUP C

COROLLA LOBES LINEAR-OBLONG OR SPATULATE, ASCENDING OR ERECT AND INCURVED

Rollinia orthopetala A. DC. Mém. Soc. Phys. Genève, **5**: 200. 1832.

A shrub or small tree resembling *R. Sieberi*. Branches and leaves very much as in that species; petioles slightly longer; leaf blades oval-oblong, acute at each end, pilose. Peduncles in pairs; calyx lobes smaller than in *R. Sieberi;* corolla wings erect and incurved.

Type in Herb. De Candolle, collected near Demerara, British Guiana, in 1824, by Charles S. Parker.

Martius, in his *Flora Brasiliensis*, gives an amended description of this species, the fruit of which he describes as "the size of an infant's head," with sweet, white, fleshy pulp. It is not certain, however, that the trees producing the fruits described by him really belong to this species. It is probably owing to Martius's description that the name *R. orthopetala* has been incorrectly applied to several species of Rollinia with large edible fruit. Of these the principal species, from an economic point of view, is *R. deliciosa*, described above, which is readily distinguished from *R. orthopetala* by its widely spreading, decurved corolla wings.

Specimens of *R. orthopetala*, with photographs of its fruits, from Demerara, its type locality, are much desired.

Rollinia laurifolia Schlecht. Linnaea, **9**: 319. 1835.

A shrub or small tree. Leaf blade oblong-elliptical or oblong-lanceolate, acuminate at the apex, obtuse at the base, the upper surface glabrous to the naked eye, the lower surface clay-colored. Corolla lobes ascending-erect, broadened and rounded or obtuse at the apex and incurved; peduncles solitary or in 2's or 3's, graduated in length, the longest about 3 times the length of the petioles. Fruit subglobose, about the size of a horse-chestnut, composed of many distinctly outlined carpels, and containing an edible white mucilaginous pulp, with a pleasant sweet taste.

Type material collected by Sellow in Brazil (Nos. 809, 1190). Known locally as *araticú mirim*.

This species bears a certain resemblance to *R. dolabripetala*, but differs from it in having the flowers in clusters of 2 to several, while the corolla wings are narrow, ascending, and incurved (instead of broad and widely diverging), and the lateral nerves and midrib are usually (but not always) hairy on the upper surface. A closely allied plant collected by Riedel (October, 1823) in the forest near Mandiocca has been described by R. E. Fries under the name *R. laurifolia* var. *longipes*. A specimen with geminate fruits recently collected and photographed at Sitio, Minas Geraes, Brazil, by Messrs. Dorsett, Shamel, and Popenoe (No. 37882) apparently belongs to this variety.

Rollinia incurva Moore, Trans. Linn. Soc. II. Bot., **4**: 303. 1894.

A diffuse shrub with short-petioled leaves resembling those of *R. laurifolia*, but obtuse at the apex and rounded at the base, glabrous and glossy above and paler beneath. Corolla wings spatulate-oblong, ascending and incurved, clothed with ferruginous tomentum.

Type in the British Museum, collected by the Matto Grosso Expedition in Santa Cruz, Brazil; duplicates of the type in the Herbarium of Columbia University, New York Botanical Garden.

GROUP D

WINGS COMPRESSED, OBOVATE AND ASCENDING

Rollinia rugulosa Schlecht. Linnaea, **9**: 316. 1834.

A shrub or small tree. Leaf blades lanceolate or broadly lanceolate, obtusely short-acuminate at the apex, acute at the base, on both sides subglabrous, beneath glossy; young branchlets, petioles, and midrib appressed-puberulous. Peduncles usually recurved or pendulous and thickened at the apex, warty and puberulous like the calyx, 8 to 10 mm. long. Corolla lobes obovate, ascending, rounded or obtuse at

the apex, narrowed at the base, tomentose-canescent, 8 mm. long, 4 mm. broad. Fruit globose, 2.5 to 3 cm. in diameter, the component carpels forming 20 to 30 slightly raised, rounded areoles. Seeds small, pale brown, conoid, somewhat flattened.

Type in the Berlin Herbarium, collected in southern Brazil by Sellow.

Closely related to *R. rugulosa* and with very similar fruit but longer and narrower leaves (suggesting those of *R. salicifolia* Schlecht.) is *R. Warmingii* R. E. Fries, the type of which was collected on Mount Tijuca, near Rio de Janeiro, by Glaziou (No. 6079).

GROUP E

COROLLA LOBES SHORT, STRAIGHT AND SPURLIKE, HORIZONTALLY DIRECTED

Rollinia lanceolata Fries, Svensk. Vet. Akad. Handl., **34**[5]: 49, pl. 6, fig. 6. 1900.

A small tree with small leaves, the blades lanceolate, acute at the apex and base, above glabrous except along the midrib, beneath densely ferruginous-villous along the midrib. Young branches, petioles, and solitary or rarely geminate peduncles ferruginous-tomentose. Flowers ferruginous-hirsute; outer corolla lobes spur-like, short, rounded, and widely spreading. Fruit not observed.

Type in Botanical Museum of Copenhagen, collected in Brazil by Glaziou (No. 13509).

GROUP F

COROLLA LOBES BROADLY OVATE OR SUBORBICULAR AND LATERALLY COMPRESSED

Rollinia emarginata Schlecht. Linnaea, **9**: 318. 1835.

A glabrescent shrub 2 to 3 meters high, growing in marshy places, with slender branches. Leaf blades, thin, membranaceous, oval or elliptical, obtuse at both ends or acutish at the base, emarginate or retuse at the apex, on both sides subglabrous and opaque. Peduncles usually solitary, slender, about 25 mm. long, minutely bracteolate at the base. Corolla and calyx silky-hirtellous; corolla wings obovate-orbicular, widely spreading, laterally compressed. Fruit solid, about 25 to 30 mm. in diameter, ovoid globose, the component carpels scarcely at all raised or distinctly outlined.

Type in the Berlin Herbarium, collected in the province of Rio Grande do Sul, Brazil, by Sellow.

This species is very common in southern Brazil and Paraguay. It is distinguished from most of its congeners by its small smooth fruit and emarginate leaves.

Rollinia glaucescens Sond. Linnaea, **22:** 557. 1849.

A glabrescent shrub. Leaf blades thinly membranaceous, ovate or lanceolate, obtuse or rarely acute at the apex, acute at the base, 5 to 7 cm. long, 2.5 cm. broad, glaucescent beneath; petioles 6 to 10 mm. long. Peduncles in pairs, one shorter than the other, the longer one bearing a small bracteole below the middle. Flowers canescent-puberulous; corolla wings broadly obovate or suborbicular, widely spreading. Fruit broadly ovoid or subglobose, small (about 2.5 cm. in diameter), solid, and smooth, the component carpels scarcely outlined and not at all gibbous.

Type collected in the Province of Minas Geraes, Brazil, by Regnell on his second expedition.

This species is closely allied to *R. emarginata* Schlecht., a species well known to Sonder. From this it differs in its leaves, which are never emarginate, and in its smaller flowers. Specimens in the U. S. National Herbarium were collected and photographed at São João de Rey, Minas Geraes, in January, 1914, by Messrs. Dorsett, Shamel, and Popenoe (No. 286). Plants have been propagated from the seed of these specimens by the Office of Foreign Seed and Plant Introduction (No. 37880).

Rollinia sylvatica (St. Hil.) Mart. Fl. Bras. **13**[1]: 18. 1841.

Annona sylvatica St. Hil. Pl. Usuelles, pl. 29; Fl. Bras. Merid., **1:** 32. 1825.

A medium-sized tree. Leaves large, elliptical, somewhat resembling those of *Annona cherimola*, but usually acutish at the base and obtuse or very shortly cuspidate, rarely oblong-elliptical and acute or acuminate, above usually puberulous, beneath softly pubescent. Peduncles extra-axillary. Fruit usually solitary, edible.

Type collected by St. Hilaire in the forests of Minas Geraes, Brazil. Fruit, locally known as *araticú do mato* (custard apple of the forest), ripening in March.

At least two species are usually found in herbaria labelled *R. sylvatica:* one with elliptical leaves, very much like those of the chirimoya, and suborbicular corolla wings; the other with lanceolate leaves shaped very much like those of *R. laurifolia*, and with spatulate corolla wings. In both, the leaves are pubescent beneath. The first corresponds more nearly to the type described by St. Hilaire, in which flowers were lacking. Specimens in the National Herbarium recently collected and photographed in the field by Messrs. Dorsett, Shamel, and Popenoe at Bom Fim (No. 436) and Lavras (No. 250) are referred to this species. Probably distinct from this is a tree growing to a height of 20 to 25 feet, rarely cultivated in gardens at São João del Rey, in

which the leaves are lanceolate, acute at the apex, and rounded at the base, very much as in *R. incurva* Moore. A photograph of a fruit-bearing branch (No. 1571) was secured. The fruit, about 4.5 cm. in diameter, is composed of comparatively few large, pointed carpels. It is yellow when mature and edible, but rather insipid. As no flowers were secured, it is not possible to place this plant in one of the groups here proposed.

ZOOLOGY.—*Ophiomaria, a new genus of ophiurans from southern South America and the adjacent portion of the Antarctic continent.*[1] AUSTIN H. CLARK, National Museum.

Two new species of ophiurans from the coast of Chile which were dredged by the *Albatross* on her journey from the Atlantic to the North Pacific represent a type which appears to be intermediate between Ophioperla and such species of Ophiosteira as *O. senoqui* Koehler and *O. koehleri* A. H. Clark, possessing the general structure of the latter combined with the granular disk covering of the former. Together with two other species, described in 1901 by Professor Rene Koehler these forms appear to represent a logical generic unit which may be known as

Ophiomaria, gen. nov.

Genotype.—Ophiomaria tenella, sp. nov.

Diagnosis.—The disk is pentagonal or more or less stellate. The dorsal surface is beset with fine granules which to a greater or lesser degree conceal the plates. In the central portion of the interbrachial spaces below there are usually numerous granules which surround, or even entirely conceal, the plates.

The arms are slender and evenly tapering, in length equal to about four times the diameter of the disk, circular in section proximally, becoming slightly flattened distally, rarely carinate.

The arm comb is represented by a narrow band of irregular plates or beadlike granules beyond the radial shields which recall the supplementary arm plates in Ophiopholis.

At the base of the arm the upper arm plates are usually very wide, narrowly oblong; they rapidly become narrowly fan-shaped, and in the distal half of the arm very small and widely separated from each other.

There are from three to five minute spaced arm spines.

[1] Published with the permission of the Secretary of the Smithsonian Institution.

The other characters are essentially as in Ophiura (Ophioglypha).

Range.—From the Antarctic regions in the vicinity of Cape Horn northward along the coast of Chile to 38° 8′ N. lat., in from 260 to 677 fathoms.

Remarks.—In addition to the two species described below, this genus includes *Ophiomaria carinifera* (Kœhler) and *Ophiomaria doederleini* (Kœhler).

Ophiomaria tenella, sp. nov.

The disk is thin and stellate, the angles continuing uninterruptedly into the arms, which taper very gradually and become very slender distally. The disk is 11 mm. in diameter, and the arms are 40 mm. long.

The central portion of the dorsal surface of the disk is covered with a close and regular fine granulation through which, in some specimens, the six small rounded primary plates are visible. Toward the periphery of the disk this granulation becomes coarser and more irregular, the granules transforming into small flat polygonal plates. In the center of the strongly excavated interbrachial margin of the disk, as viewed dorsally, there is a transversely oval or semicircular plate, usually about twice as broad as long; between this and the radial shields on either side there is usually a plate about half as large, more or less circular or irregularly polygonal in outline, and a few, very irregular, much smaller plates. Within this interbrachial border, as within the most proximal plates in the columns separating the radial shields, there may be a few irregular polygonal plates bordering the granular covering of the central portion of the disk.

The radial shields are irregular rounded triangles, nearly or quite twice as long as wide, about as long as the width of the arm immediately beyond the disk. The radial shields of each pair are separated interiorly by a series of two or three plates of which the innermost is considerably longer than the others; between this last and the granulation of the center of the disk there are usually a few irregularly polygonal plates of various sizes. From the distal end of the outermost plate in the series between the radial shields there runs around the distal borders of the latter a series of two or three or more irregular plates (more rarely a double series) which takes the place of an arm comb. The upper surface of these plates is even both with that of the radial shields and with that of the arm plates beyond them.

The interbrachial spaces below are filled with irregular polygonal scales which are largest along the lateral borders, becoming smaller and more or less surrounded by or covered with granules centrally; toward the oral shields they tend to imbricate more or less.

The genital slits are long, reaching from a notch in the middle of the sides of the oral shields to the border of the disk as viewed ventrally; they are bordered with small truncate closely crowded papillae.

The proximal edges of the oral shields are straight and make nearly

a right angle with each other; the sides are roundedly incised by the proximal ends of the genital slits; the outer corners are broadly rounded; and the distal border is concave or sometimes convex. The length of the oral shields is equal to, or slightly exceeds, the breadth.

The mouth papillae are five in number; the innermost is triangular and sharp pointed, the others lower, truncated distally. Continuing these is a series of five, more rarely six, papillae bordering the first arm tentacle abradially, of which the outermost is broad and triangular, with the apex over the proximal end, the others small, subequal, rounded distally; opposite these on the first under arm plate are two, rarely three, large tentacle scales, of which the outermost is about as large as the outermost in the other series, and twice as large as the inner.

The side mouth shields are narrow, about four times as long as broad, with parallel sides, and incised near their outer ends by the furrows lodging the first arm tentacles.

The first upper arm plate distal to the row of plates bordering the radial shields is very narrow, almost bandlike, nearly spanning the arm in dorsal view; the next is longer and wider, with converging sides and a convex distal border; the following ones decrease regularly in width, increasing in relative length, at the fifteenth or sixteenth becoming triangular, twice as long as broad, with the distal border strongly convex; beyond the sixteenth each upper arm plate is separated from the preceding by an increasingly greater relative distance, as a result of the increasingly broader union of the side arm plates.

The arm spines are very short and slender, on the first ten side arm plates three or four, commonly in two well spaced pairs, beyond these five, toward the end of the arm four, usually in two spaced pairs, and at the tip of the arm three. At first the arm spines are equal in length and size; beyond the basal third of the arm the lowest increases in relative length, soon becoming twice as long as the others.

The first under arm plate is fan-shaped, the outer border strongly convex, the very short inner border strongly concave. The second is usually slightly longer, twice as broad proximally, the lateral borders slightly concave, the distal border with a median convexity and two slight lateral concavities; the tentacles on either side are protected by four scales inwardly and three outwardly. The third is similar, but with a much narrower base and more converging sides. The fourth is rhombic. The fifth is rhombic, shorter, in contact with the fourth. The next two are shorter, rhombic, but with the outer angles cut away by the tentacle grooves, widely separated from each other. The following ones have a low convex distal border and the outer part of the proximal border cut away by the tentacle grooves. Beyond the middle of the arms the under arm plates lie entirely between the tentacle grooves; they become very minute in the distal portion of the arm.

Type.—Cat. No. 38580, U. S. N. M., from *Albatross* Station 2785, off the coast of Chile, in 449 fathoms.

Ophiomaris rugosa, sp. nov.

In the largest specimen the disk is 16 mm. in diameter, and the arms are about 50 mm. long.

The disk is pentagonal with slightly concave sides, less stellate than that of *O. tenella*, thick, at the angles of the pentagon curving abruptly downward to the arm bases. It is covered dorsally with fine granules which become coarser toward the margin, where they tend to transform into an irregular mosaic of small, very irregular, polygonal plates, especially at the arm bases; the radial shields are covered.

The granulation of the disk may cover uniformly all of the plates, but usually one or more of the following series are visible; six widely separated circular or oval primary plates, much swollen and elevated above the general surface; a similar plate at each arm base, with sometimes a small one beyond it; between the plates at the arm bases a similar but smaller plate, about the size of the central plate, in the mid-interradial line; a small plate on either side of a line between each peripheral primary plate and the plate at the base of the corresponding arm; a plate in the middle of each interbrachial border, as viewed dorsally, which sometimes forms the center of a series of very irregular plates between the arm bases.

The arms are essentially as in *O. tenella*, but the side arm plates and upper arm plates are rather strongly convex in profile, so that the arms appear rugged.

The plates in the interbrachial areas below are much smaller than the corresponding plates in *O. tenella*, and the granules are more abundant, smaller, and more generally distributed.

On the ventral surface there appear to be no essential differences between this species and *O. tenella*.

Very young individuals with the radial shields exposed differ from young specimens of *O. tenella* in having smaller and more numerous central plates on the dorsal surface of the disk, and swollen arm plates.

Type.—Cat. No. 38579, U. S. N. M., from *Albatross* Station 2791, off the coast of Chile, in 677 fathoms.

PHYSIOLOGY.—*Food economics.*[1] GRAHAM LUSK, Professor of Physiology, Cornell University Medical College, New York.

The consideration of the food supply from a national standpoint was forced upon Germany at the outbreak of the great war which is now in progress. Eminent scientists combined in a report upon the prospects of the sustenance of the nation.

[1] A lecture delivered before the Washington Academy of Sciences, April 14, 1916.

Imports from oversea had been restricted. Meat, butter, cheese, and fish formerly obtained from Holland and Denmark were no longer available. The North Sea fisheries which had yielded 179,000 metric tons (1 metric ton = 2200 lbs.) of fish were closed, trained farm hands were fewer, crops in East Prussia and Alsace had been destroyed; the situation appeared serious. It was estimated that the annual amount of food fuel necessary to support sixty-eight million Germans—men, women, and children—was 56,750,000,000,000 calories. This is the equivalent of 3000 calories per adult per day. The quantity of protein required in this fuel, if the human machines were to maintain themselves in self-repair, was estimated to be 1,605,000 metric tons per annum. It was calculated that a mixed population of sixty-eight millions (men, women, and children) required the same amount of food as would 51,823,000 adults.

In order to increase the production of food and to diminish the waste, the committee recommended increasing the crop of beans, with its large protein content, reducing the unnecessarily large meat supply, and increasing the intake of cheese and skim milk (which latter should no longer be fed to pigs), improving the yield of vegetables and fruits, and reducing the quantity of butter and cream produced. A reduction in the consumption of meat, butter, and cream was necessary, because edible grains would be required for human food, and the maintenance of the usual number of cattle was no longer deemed possible.

The estimated savings as above enumerated would result in a total production of 81.25 billion food calories containing 2,022,800 tons of protein.

The conditions were summarized as shown in table I.

From these data it was concluded that the German people, through cooperation of millions of inhabitants, would be able to prevent suffering for lack of food. There can be no question that respect for the scientific knowledge of specialists, of men like Rubner, Zuntz, Oppenheimer, and Lehmann, was of highest value in the hour of national exigency. Countries in which highly educated men are very slightly esteemed would have

passed over this advice, would have consigned it to the newspaper dung-hill of "highbrow" information, and starved to death in consequence.

TABLE I

SHOWING THE ANNUAL FOOD REQUIREMENTS OF 68,000,000 PEOPLE IN GERMANY

	PROTEIN IN 1000 METRIC TONS	CALORIES IN BILLIONS
Actual requirement	1605	56.75
Used before the war	2307	90.42
Available (unchanged habits)	1543	67.86
Available (under present recommendations)	2023	81.25

It is not unimportant to know something of the cost of these great quantities of food fuel.

If one takes the wholesale cost in the United States of food purchased on account of the Commission for Relief in Belgium as a basis, one can estimate, in terms of the cost of various simple food-stuffs, the lowest wholesale cost of the yearly food fuel requirement of the German nation, as follows:

TABLE II

WHOLESALE COST IN AMERICA OF FOOD FUEL FOR 68,000,000 PEOPLE

	COST PER POUND	COST PER 1000 CALORIES	COST FOR 56,750,000,000,000 CALORIES
Corn meal	$0.016	$0.011	$634,000.000
Wheat	0.023	0.014	794,500,000
Rice	0.03	0.018	1,022,500,000
Flour	0.033	0.02	1,135,000,000
Beans	0.045	0.029	1,634,000,000

The wholesale cost of sufficient food fuel exclusively in the form of beans to provide the United States for a period of one year would call for a sum of two and a half billion dollars. Beans are more costly than rice and wheat, but have a larger protein content.

Contrast the stupendous cost of food fuel for a nation with the living expenses of a poor family in New York City (table III).

To the man of large affairs the expenditure of twenty-five dollars a month for food appears of little moment, and yet if the 100,000,000 inhabitants of the United States lived as this

TABLE III

FAMILY, TWO ADULTS, THREE CHILDREN

Wages	$60 per month
Rent	$15.00
Food	25.00
Coal	4.50
Insurance	2.25
Soap, matches, etc.	1.00
Clothing and extras	12.25
	$60.00

typical poor man's family lived the cost of food would aggregate $6,000,000,000 per annum. To any man of large affairs the maintenance at Boston of the Nutrition Laboratory of the Carnegie Institution, with its budget of $60,000 per annum, appeals impressively to the imagination; yet this work is accomplished at an annual expense of one-thousandth of one per cent of what the American people would pay for food if each family of five had an income of $720 per annum. Is it not a little sad to think that the expenditure of thousands of millions of dollars annually for food, an expenditure frequently amounting to more than half of the income of the poor man, should take place without any real idea as to the nature of what food is?

TABLE IV

SUPPLIES FOR A BOARDING SCHOOL CONTAINING 355 BOYS

	PROTEIN METRIC TONS	FAT METRIC TONS	CARBOHYDRATE METRIC TONS
Food supply	20.5	25.6	60.5
Waste	3.8	5.4	4.2
Food-fuel	16.7	20.2	56.3

Mr. F. C. Gephart, of the Russell Sage Institute of Pathology, has made a study into the food consumption of the boys at St. Paul's school at Concord, New Hampshire, one of the largest

private boarding schools in the country. The total annual food supply has been computed as shown in table IV.

This amount of nourishment was taken by 355 boys and by about 100 adults (masters and servants). This quantity of food when computed on the basis of the individual meal served appears as follows:

TABLE V

FOOD SUPPLY PER MEAL

	POUNDS	GRAMS	CALORIES	CALORIES
				per cent
Protein	0.1107	50.2	206	14*
Fat	0.1332	60.4	562	39
Carbohydrates	0.3717	168.8	692	47
			1,460	100

* 70 per cent of this is in animal protein.

The cost of this food per meal was 20 cents, or 13.8 cents per 1000 calories. The food, which was bought by a purchasing agent in the Boston market and was of the best quality, included 193 separate varieties. Such a dietary taken by the 100,000,000 inhabitants of the United States would cost per annum 11½ billion dollars, if the German minimum of 3000 calories daily per adult were allowed. This cost is twice what the poor man in New York City pays for his food.

These growing athletic boys, however, were not satisfied with 3000 calories daily. They not only took 4350 calories daily at the table, but they bought 650 additional calories in food at a neighboring store, the principal item being chocolate.

Data concerning the subjects of the investigation are epitomized in table VI.

The basal requirement of boys is, as Du Bois has shown, 25 per cent above that of the adult. The total fuel intake was three times that of the basal level, which is the heat production when a boy is resting or asleep. The 5000 calories contained in the ingesta is half as much again as a farmer at work would require. The quantity of the calculated intake would certainly not be lowered by excluding the adults who unavoidably entered

into this computation. These results explain the ravenous appetite of boys. Lack of appreciation of this factor and lack of provision for it are the probable causes of much of the undernutrition seen in children of the school age.

TABLE VI

TABLE SHOWING THE NUTRITION CONDITIONS AT A SCHOOL CONTAINING 355 BOYS

	AVERAGE AGE	HEIGHT	WEIGHT	BODY SURFACE	BASAL METABOLISM (CALC.)	FOOD	FOOD IN PER CENT OF BASAL
	years	*cm.*	*kg.*	*sq. m.*	*cals.*	*cals.*	*per cent*
The Upper School	16	172.7	60.6	1.73	1826	4997	274
The School	14½	165.1	50.8	1.54	1737	5126	295
The Lower School	13½	157.5	43.8	1.40	1647	4949	300

The distribution of the fuel values among the various more common articles taken as food at the school is shown in the following table:

TABLE VII

PERCENTAGE DISTRIBUTION OF THE CALORIES INGESTED AT A BOYS' BOARDING SCHOOL

	Per cent		*Per cent*
Bacon	1.8	Lamb	5.3
Beef	6.7	Milk	12.6
Bread and flour	13.3	Pork loins	1.1
Butter	11.2	Potatoes	5.9
Cream	1.3	Sugar	11.6
Eggs	2.3	Other items	24.5
Fowl	1.9		

It is interesting that twelve dietary items yield 75 per cent of the fuel value, and that 181 other varieties yield the remaining 25 per cent. Bread, butter, milk, and sugar together yield 50 per cent of the food fuel.

According to the German minimum allowance an average family of five (father, mother, and three children) would require 11,400 calories in food daily. If the family's dietary were based proportionately upon that of the boy's school, it would cost as follows (table VIII), provided its food supplies were purchased on Second Avenue, New York City:

TABLE VIII

	CALORIES	COST IN CENTS
Total food	11,400	
Bread	1,500	5
Butter	1,500	5
Milk	1,500	16
Sugar	1,500	4
	6,000	30

Thirty cents will buy more than half the family's food requirement at an average cost of 5 cents per thousand calories, instead of 14 cents, the average cost at the school. If $25 is spent each month for food, 80 cents a day is available, or 7 cents for a thousand calories. The margin is narrow.

It would be well if the family knew that more than half its food supply could be had for 30 cents a day, and that this bread, butter, milk, and sugar are of equal nutritive value to the best the country affords. The remaining 5400 calories could then be bought at a cost of 9 cents per thousand. This sum will purchase most of the usual foodstuffs, with the exception of meat.

As a matter of statistics, the annual consumption of cane sugar in the United States in 1912–13 reached 85.4 lbs. per capita, which is the equivalent of 2000 calories daily for a family of five, or twenty per cent of the energy requirement. This quantity of sugar costs the nation a million and a half dollars daily, and the rich harvest to be reaped by substitution of only a part of this by saccharin, which has no fuel value whatever, is obvious.

It has appeared to those at work in the laboratory that it would be of great importance to associate the caloric value of food with cost in dollars and cents. For the understanding of this, table IX has been prepared, showing the cost of 2500 calories, which is the energy requirement of an average adult of sedentary occupation.

True food reform demands the sale of food by calories and not by pounds. Professor Murlin has advocated that the

TABLE IX

WEIGHTS OF VARIOUS FOODS NECESSARY TO FURNISH 2,500 CALORIES, AND COST AT SECOND AVENUE AND 90TH STREET, NEW YORK CITY

A man at moderate work requires 2,500 calories daily

ARTICLES	WEIGHT		COST
	Pounds	Ounces	
Corn meal	1	8	$0.04½
Hominy	1	8	0.04½
Oatmeal	1	5½	0.05¼
Flour	1	8	0.06
Sugar	1	5½	0.06⅔
Rice (broken)	1	8½	0.07¼
Bread	2	1	0.08¼
Lard		9½	0.08 5/16
Corn syrup	1	13	0.09⅜
Molasses	1	15	0.12 11/16
Peanut butter		14	0.14
Pork (fat)	1		0.14
Beans (dried), pea	1	9	0.14
Oleomargarine		11	0.15 3/16
Potatoes	8	1	0.16½
Dates	1	12	0.17½
Olive oil		9½	0.19
Hickory nuts (unhulled)	2	0	0.20
Raisins (dried)	1	12	0.21
Applies (dried)	1	13	0.21¾
Cheese, American, pale	1	3	0.23¾
Butter		11	0.24 1/16
Brazil nuts (unhulled)	1	8	0.27
Cocoa	1	1	0.29 5/16
Lentils (dried)	1	8	0.30
Almonds (unhulled)	1	8	0.36
Apples (fresh)	11	5	0.38
English walnuts (unhulled)	1	13	0.41 11/16
Salt cod	6		0.90

government compel manufacturers to place upon each can or package of food sold the caloric content of the package.

Besides fuel value it must be remembered that the body must have protein. The machinery of the living parts of the body such as muscle is in a constant state of wearing away. The wear and tear is slight, but protein must be taken in the food

to replace that destroyed in the body or the machinery of the cells will wear out and death from lack of protein will ensue.

Different proteins have different values for this purpose. Those of meat, fish, eggs, and milk will replace body protein part for part. Such proteins may be classified as proteins of Grade A. Gelatine has practically no power to replace body protein and should be classified as protein of Grade D. Wheat contains a mixture of proteins of Grades A and D in which those of Grade A predominate, so that wheat may be classified as containing protein of Grade B, whereas from analogous reasoning corn may be said to contain protein of Grade C.

An ordinary dietary with a liberal allowance of protein contains 15 per cent of its calories in that form. A can containing 15 per cent of its calories in protein should have a star placed with the letter determinative of the grade of protein. For example the label on a can of corn should read, "This can contains x calories of which y per cent are in protein of Grade C." A further desirable statement would be as to whether the foodstuff sold contained the natural mineral constituents from the organic source from which it was derived.

I have elsewhere emphasized the desirability that the government should give this information with regard to all foodstuffs sold in packages. The determination of the heat of combustion of a dried sample of food takes fifteen minutes. Probably three hours would suffice to make a complete analysis by a government expert. The manufacturer should send his sample can to the Bureau of Chemistry at Washington, declaring that to be his standard and requesting information regarding his label. He should pay for this analysis as a patentee pays for his patent. If at any time the government should find the manufacturer selling on the market a material of different character than the standard deposited with the government, the manufacturer should be heavily fined.

It is not possible to consider the details of the great amount of extremely valuable work accomplished by the scientific departments of the Washington Government and in the individual

Agricultural Experiment stations in this country and abroad. It may, however, be of interest to call attention to the results of a study of the sale of food at Childs' restaurant[2] which shows how this principle of caloric feeding, now adopted in hospitals and upon farms, may be worked out in the daily life of the people.

The main objection that has been encountered to the sale of food on the caloric basis has been the sensitiveness of the business world to the introduction of a new and unknown quantity. Why not leave well enough alone? A more highly educated generation will, however, demand that its expenditures of thousands of millions of dollars for food shall not continue to take place in unfathomable depths of darkness.

[2] Gephart and Lusk. Analysis and cost of ready-to-serve foods. Published by Am. Med. Assoc., 1915.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

TERRESTRIAL MAGNETISM.—*Results of observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Tucson, Arizona, 1913 and 1914.* DANIEL L. HAZARD. U. S. Coast and Geodetic Survey Serial Publication No. 23. 1916.

This publication is in continuation of the series giving the results obtained at the Tucson magnetic observatory since its establishment in 1909. It contains a summary of the monthly determinations of the scale-values of the horizontal intensity and vertical intensity variometers; the base-line values derived from the weekly absolute observations; diurnal variation tables for the magnetic elements D, H, and I, the total force F, and the rectangular components X, Y, Z; hourly values of D, H, and Z, together with daily and hourly means for each month; a tabulation of the earthquakes recorded on the seismograph; a list of the magnetic disturbances of considerable magnitude, and reproductions of the magnetograms showing the more marked disturbances. Attention is called to the fact that beginning with 1913 intensity results obtained by this Bureau have been reduced to the international standard of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Published results for earlier years must be diminished by one part in a thousand to reduce them to that standard.

D. L. H.

TERRESTRIAL MAGNETISM.—*Solar radiation and terrestrial magnetism.* L. A. BAUER. Terr. Mag., **20**: 143–158. 1915.

Comparisons have been made between the records of magnetic variations and those of the solar constant as determined by Abbot. If the local magnetic constant G be defined as $(H^2 + \frac{1}{4} Z^2)^{\frac{1}{2}}$, where H and Z are horizontal and vertical magnetic intensities respectively, it is found

that the 1913 results from 8 magnetic observatories indicate on the average an increase of about 0.002 of a per cent in G, and a decrease of about 1 per cent in the magnetic diurnal range for a decrease of 1 per cent in the solar constant.

It is shown further that the eclipse magnetic effects are of the same sign, and of the same order of magnitude as the magnetic effects which are, apparently, to be associated with about a 10 per cent decrease in the value of the solar constant.

It is found that on consecutive quiet days the magnetic constant is, on the average, larger on the second day than on the first by an amount equal to that which would be caused by the average daily change in the solar constant. If the quiet day magnetic effect were to persist throughout the year, it would cause a secular variation fully 10 times that generally observed. However, the quiet days are in the minority, and on the unquiet days the effect is in a direction opposite to that for the quiet days. Since there is not a complete compensation between the two opposing effects when integrated throughout a period of a year, part of the *observed* secular magnetic change should be of a type related to the annual change in solar constant. W. F. G. S.

PHYSICS.—*On the ionization of the upper atmosphere.* W. F. G. SWANN. Terr. Mag., **21**: 1–8. 1916.

If the sun is taken as a black body, and if in accordance with the experiments of Hughes, ionization does not set in below wave length 135 $\mu\mu$, it appears that only about 1.6×10^{-5} of the total solar radiant energy is available for atmospheric ionization.

The results are applied to an example cited by Schuster in connection with his theory of the diurnal variations of terrestrial magnetism. Schuster concludes that if the upper atmosphere is treated as a shell 300 kilometers thick, at a pressure 1 dyne per square centimeter, a conductivity of 10^{-13} e. m. u. would have to exist in it in order to account for the necessary magnetic effects. The author finds that only about 10^{-3} of this amount can be accounted for in such a shell, by the ultra-violet radiation, and even if the whole of the sun's energy could be absorbed in producing ionization, the conductivity accounted for would yet be far too small.

The above conclusion is not intended as a criticism of Schuster's theory, however, since the ultra-violet light is not the only source of ionization in the upper atmosphere. Further, it is shown that if the calculation is not limited to a shell, but if account is taken of the infi-

nite extent of the atmosphere, the magnetic effects which result as the ultimate consequence of a feeble source of ionization may be very much greater than those calculated on the basis of a shell of finite thickness.

W. F. G. S.

PHYSICS.—*Protected thermoelements.* ARTHUR W. GRAY. Bureau of Standards Scientific Paper No. 276. Pp. 3. 1916.

The mounting described in this paper has been found to be very convenient for protecting laboratory thermoelements from damage by contamination or by mechanical strains.

The closed tube which covers the temperature determining end of the thermoelement has its open end cemented into one end of a flexible copper tube, through which the wires, properly insulated, pass to a head at the other end. Projecting downwards, from this head is a glass tube which contains the ice junction. The head is provided with neutral binding posts for receiving the leads to the apparatus employed for measuring the electromotive-force by which the temperature is determined, and contains phosphorus pentoxide to prevent moisture films from being deposited within the protective covering.

The ice-bath is contained in a vacuum jar which is protected by a metal case. By means of a bayonet joint this is suspended from the cover, which is fastened to a rod fitting the standard laboratory clamps. The head of the thermoelement telescopes with moderate friction into a split tube which projects upward from the top of the ice-bottle cover. When it becomes necessary to renew the ice, a slight turn of the case containing the vacuum jar frees the bayonet joint and permits lowering of the ice-bath without disturbing anything else.

A. W. G.

SPECTROSCOPY.—*Interference measurements of wave lengths in the iron spectrum (3233A–6750A).* KEIVIN BURNS, W. F. MEGGERS, and PAUL W. MERRILL. Bureau of Standards Scientific Paper No. 274, pp. 245–272. 1916.

The wave lengths of 403 iron lines have been measured by means of interferometers in an effort to determine standards at intervals of about 10 angstroms. This has been accomplished in the greater part of the spectrum between 3233A and 6750A, the region in which the International secondary standards exist. As far as possible, lines of all intensities were measured.

The arc spectrum of iron was used in accordance with the recommendations of the International Wave-Length Committee. The method of procedure was that of Buisson and Fabry (*Journal de Physique*, **7**: 169. 1908). Most of the wave lengths were determined by means of three or more interferometers in which the orders of interference ranged from 15 to 60 thousand waves. The International secondary standards were used in this comparison instead of the fundamental cadmium standard. The mean difference between the present observations and the International standards is about one part in four million.

Comparisons with all the grating observations of iron lines which have been made on the I. A. system prove that more secondary standards were needed to obtain the highest accuracy in grating interpolations. Some of the grating observations show a difference in wave length which is a function of the intensity of the line. The measurements with the interferometer appear to be quite free from this effect.

In the course of the investigation over 600 lines were examined by means of several interferometers in order to discover the limiting orders of interference. This gave an idea of the width or sharpness of each line. The data on sharpness were then correlated with intensity, pole effect, and pressure shift. K. B.

GEOLOGY.—*Geology and oil prospects of the Cuyama Valley, California.* WALTER A. ENGLISH. U. S. Geological Survey Bulletin 631 M, pp. 191–215. 1916.

The Cuyama Valley area lies within the California Coast Ranges, south of the important oilfields which border the San Joaquin Valley along its southwest side. Although written primarily as a discussion of the oil possibilities the report also brings out certain features of the complicated Coast Range structure and stratigraphy.

The rocks outcropping are a thick Cretaceous formation of dark shale, and Tertiary clayey and diatomaceous shales and sandstones. The Cretaceous beds are quite uniform in lithologic character and vary little from beds of the same age in other parts of the Coast Ranges. The Tertiary formations, however, are of extremely variable lithology. During parts of Tertiary time the shore line probably crossed the Cuyama area, for in going from west to east within this area the lower and upper Miocene rocks are traceable from marine beds typical of Coast Range deposition into non-marine beds of the type of the Tertiary formations present in the Mojave and Tehachapi regions to the

east. Lithologic variations within the marine beds are due to local differential uplifts which occurred during Tertiary time, and which formed long island ridges in the sea which then covered the present Coast Ranges. These Tertiary differential uplifts also served to complicate the structural features of the region. The present Coast Ranges are made up of a series of long northwestward trending ridges, the individual ranges of the system, separated by wide valleys. These ranges and valleys are of structural origin, having been formed by the pronounced folding and faulting of early Pleistocene time. The structure resulting from the comparatively recent folding is superimposed upon structures formed by similar earlier movements. An interesting result of this combination of structures is that, although the general trend of the major lines of structure produced by the earlier movements was northwest, and thus parallel to the later structure, the blocks subjected to differential uplift during the earlier part of the Tertiary were not always the same as those most recently uplifted. An area which formed a range during the Tertiary and from which many thousand feet of beds were eroded may now form the bottom of a structural valley, and another area which was a structural trough during parts of the Tertiary may now form a recently uplifted range. W. A. E.

BOTANY.—*Studies of Tropical American phanerogams—No. 2.* PAUL C. STANDLEY. Contributions from the U. S. National Herbarium, **18**: 87–142. 1916.

The paper consists of descriptions of new species and of taxonomic notes upon various groups of plants, chiefly the Amaranthaceae, Allioniaceae, Malvaceae, and Rubiaceae, and the association of families formerly known as the Leguminosae. Most of the new species are based upon material obtained in Panama by Mr. Henry Pittier. A large number of species published in the genus *Pisonia* are transferred to *Torrubia*. A new genus of the Malvaceae, *Wercklea*, based upon a showy-flowered tree of Costa Rica, is published jointly with Mr. Pittier. *Peltaea*, a new genus of Malvaceae, embracing 4 species, is proposed and *Lopimia*, of the same family, is restored. There are included descriptions of three new species of persimmons (*Diospyros*) from Mexico, and 11 species of *Psychotria* from Panama. Two genera of Rubiaceae, *Cassupa* and *Stachyarrhena*, are reported from North America for the first time. P. C. S.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 774th meeting was held on May 13, 1916, at the Cosmos Club, President BRIGGS in the chair; 53 persons present. The minutes of the 773d meeting were read in abstract and approved. After discussion the following resolution recommended by the Executive Committee was unanimously carried:

Resolved: That the Philosophical Society of Washington most heartily approves of House of Representatives bill No. 528 (known as the Johnson bill) for the adoption of the Centigrade temperature scale in Government publications with the amendments as approved by the National Academy of Sciences.

Mr. C. W. HEWLETT of the Johns Hopkins University presented a communication on *The analysis of complex sound waves* and exhibited and demonstrated the apparatus used in the investigation. The speaker first gave an example to show what is meant by the analysis of a complex sound wave. Suppose we have three tuning forks whose frequencies are related to one another as are the numbers 1, 2, and 3, and let us consider the sound waves passing through a point at some distance from the forks. If each of the forks were excited separately we should observe at the point in question three simple harmonic trains of waves of definite intensities with frequencies corresponding to the frequencies of the forks. If all the forks were excited together we should observe a complex train of waves passing through the point, and by a proper arrangement of apparatus this complex wave could be analysed. If our analysis led to the conclusion that the complex wave was composed of the three simple harmonic trains which we observed when the forks were excited separately, then we should say that the analysis was correct. But, as is well known, a Fourier analysis could be carried out which would lead to an entirely different result, and it would also be a correct analysis in the sense that the portion of the complex wave analysed could be reproduced by the combination of the components found by the analysis. Again suppose that the three forks had frequencies whose relations to one another were the same as the numbers 1, 2.1, and 3.5. The complex wave from these three forks could again be analysed, and the analysis would be again regarded as correct if it gave us three simple harmonic trains of waves with frequencies corresponding to those of the forks and intensities which we would observe with the forks vibrating separately. But a Fourier analysis in general would give us an entirely different result,

and this analysis would also be correct in the sense that the portion of the wave analysed could be reproduced by combining the components found by the analysis. We thus see that a Fourier analysis does not necessarily tell anything in regard to the physical apparatus giving rise to the complex sound wave. If, however, the complex wave be explored by a system of tunable resonators the analysis so found does give information in regard to the source. The apparatus exhibited consisted of such a series of resonators. The detecting device is a Rayleigh disc suspended in the opening of the resonator and deflections are measured by a beam of light reflected from the disc.

Discussion. Mr. SWANN raised questions regarding what was really of importance to the ear and whether a physical analysis can be of the same nature as that of the ear's system. In experimental work the mounting and operation of a musical instrument is entirely mechanical and without any of the effects due to a player's skill when using the same instrument. The ear apparently appreciates the energy. Mr. C. A. BRIGGS said that the mechanical receipt of sound by the ear might be explained by the reed frequency indicator. Mr. CURTIS suggested that an improvement might be obtained by using a model of the ear's system for experimental work. Mr. WEAD called attention to the fact that a large part of detail of the ear's system as generally described is due to handling in cleaning and cutting, and does not correspond to anything in the living ear. In music fixed pitch is not wanted. Mr. HEWLETT stated that he hoped to take up later experimental work in connection with mechanical playing.

By invitation, Mr. J. A. ANDERSON of Johns Hopkins University then presented a paper on *Diffraction gratings; their preparation and use.* A reflecting diffraction grating consists of a polished plane or spherical metallic surface on which are ruled a great number of lines or grooves, all of which must be straight, parallel, and equidistant from each other. In practice these conditions are never satisfied absolutely, and the question arises as to what deviations from ideal conditions may exist without impairing the quality of the grating. A discussion shows that the lines should not have a radius of curvature of less than 3 kilometers, and the distance between them should be so nearly constant that the deviation of the last line from its ideal position should not exceed one-quarter of a wave-length. The design and construction of a machine for ruling perfect gratings is a very difficult problem, but it was solved so completely by Professor Rowland that by following him intelligently it does not now present any insurmountable difficulties. The parts of the machine must be carefully tested; methods for doing this were explained. The machine is finally tested by the method of "cross rulings," a method devised by Professor Rowland, and which is so sensitive that errors in spacing as small as $\frac{1}{3{,}000{,}000}$ inch can be detected with ease.

Discussion. Following the exhibit of a number of gratings and cutting tools Mr. ABBOT asked regarding the life of a ruling tool and

largest gratings made. Mr. Anderson stated that all of the gratings were made on speculum metal. This is crystalline and therefore, owing to occasional pitting, subjects the tool to slight falls with the result that the diamond may chip; the natural edges of the diamond are used for cutting; with care one tool will rule from 6 to 10 miles. The diamond would stand indefinite use on soft metals such as silver; if soft metals could be given as high a polish as speculum metal it would be possible to rule large gratings. Messrs. HUMPHREYS and WRIGHT cited a number of examples of diamonds that cannot be cut by the lapidary; they are designated as "knots." Mr. BAUER asked what is the largest number of lines ruled to the inch. Mr. Anderson stated that he had himself ruled 15,000 lines to the inch and was building a machine to rule 30,000; Professor Rowland had ruled one grating with 86,000 lines per inch but that grating had been lost; among the gratings exhibited was one with 43,000 lines per inch by Professor Rowland.

The chair extended to Messrs. Anderson and Hewlett the thanks of the Society for their very interesting papers.

J. A. FLEMING, *Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 308th meeting was held in the lecture room of the Cosmos Club on April 12, 1916.

REGULAR PROGRAM

J. S. DILLER: *Geologic history of Lassen Peak.* Lassen Peak is an ancient volcano at the southern end of the Cascade Range and fills the gap between the northern end of the Sierra Nevada and the Klamath Mountains composed largely of old sedimentary rocks.

Its volcanic activity began near the close of the Eocene, was greatest during the Miocene and Pliocene and decreased in the Quaternary to near extinction.

Lassen Peak is a volcano of large type surrounded by many smaller ones of later date, the whole being built up by many explosive and effusive eruptions of a notable variety of lavas. The earliest lavas are andesite, but the differentiated magma appeared later on the one hand as dacite and rhyolite, and on the other hand as basalt and quartz basalt.

In developing the peak the great volcanic vent migrated nearly 4 miles to the northwest, erupting first andesite, then dacite, which built up Lassen Peak to its present height, 10,460 feet. Later, only a few centuries ago, dacite was erupted at the northwest base of the peak forming Chaos Crags, but finally activity began again May 30, 1914, erupting dacite in the old crater of the highest summit. The basalts are mainly in the peripheral region.

In the discussion Diller asserted that the flashes of light, cloud glows and rocket-like incandescent bombs shot from the crater prove that at least some of the new lava erupted was hot enough to be luminous, and

the flow structure in some of the breadcrusted bombs shows them to have been viscous.

ARTHUR L. DAY: *Volcanic phenomena at Lassen Peak.* Since the outbreak in 1914, Lassen Peak has shown four phases of activity which may be called volcanic. The first phase began on May 30, 1914, with a series of sharp explosions in the old summit crater, which developed an opening in the scoriaceous débris at the bottom of the crater some 25 by 40 feet in size and perhaps 30 feet deep. These explosions were followed by others with increasing violence for several weeks, until the new opening reached a length of 900 feet or more. No fresh lava or other evidences of heat or chemical action appeared during this phase of the activity.

On May 21, 1915, the most violent explosion thus far noted took place, and was accompanied by a horizontal blast down the northeast flank of the mountain (phase 2), a mud flow (phase 3) following the blast, and a summit upheaval (phase 4) of much greater magnitude than any which had preceded it. The lateral blast was similar in its character and effects to the "Nuées Ardentes" of Mont Pelée, so accurately described by Lacroix. The temperature, however, though sufficient to melt the vast accumulations of snow on this flank of the mountain, and thus to cause the mud flow, was nevertheless insufficient to start a general conflagration of the kind which was visited upon Saint Pierre. The only evidences of combustion were confined to a single small area where local conditions interrupted the path of the blast and increased the time of exposure to its heat. A similar blast occurred on May 23.

That the mud flows were caused by the melting snow on the outer flanks of the mountain, rather than by an outflow of mud from the crater, as at first reported, is plainly established by the observation that no mud is found within some 1500 feet of the summit. The devastation caused by the mud flow was, nevertheless, of considerable magnitude, and involved some 5 million feet of standing timber, much of which was swept away, root and branch.

The upheaval at the summit, lifting a considerable portion of the bottom of the old crater, including sections of the east and west rims, but not being sufficiently powerful to hurl it completely off from the mountain top, produced the appearance of an area which has been effectively dynamited. At the east end, where the lateral blast found vent, some large boulders were split off and were carried by the mud flow into the valleys below. The remaining upheaved matter fell back in a wild chaos of boulders, the summit of which is now 200 feet or more above the lowest point of the old crater bowl.

A visit to this upheaved area about 4 weeks after the occurrence revealed a few cracks, adjacent to the center of explosive activity, from which hot gases were still escaping. Except for the rocks and ash adjacent to these cracks, all the upheaved matter was cold. From this and other surface indications, it seems impossible to conclude that any fresh lava reached the surface, nor could any considerable evidence of chemically active gases be found.

On the northeast flank of the mountain, a mile or more from the crater, a few breadcrust bombs were found, but these are angular in contour and are deemed to have acquired their breadcrust surface from superficial rather than from initial plasticity. Proof of this is found in the fact that some of the breadcrusted material is nothing more than scoriaceous tuff. No evidence was discovered that the breadcrusting was associated with the May outbreak.

The absence of convincing evidence of very high temperatures, or of chemically active gases, suggests the conclusion that the activity may have been caused by explosions of superheated steam resulting from the approach of meteoric water to the volcano hearth.

CARROLL H. WEGEMANN, *Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 556th regular meeting of the Biological Society of Washington was held at the Cosmos Club, Saturday, May 6, 1916; called to order by President HAY at 8 p.m., with 45 persons present.

On recommendation of the Council VICTOR J. EVANS, Washington, D. C., was elected to active membership.

The President announced the recent deaths of CHARLES A. DAVIS and S. M. GRONBERGER, members of the Society.

The first communication of the regular program was by M. W. LYON, JR., *Longevity of bacteria.* Dr. Lyon described a culture of *Bacillus paratyphosus B.* which had been hermetically sealed in a glass tube in ordinary culture medium for the past ten years, and exhibited a living subculture which had been made from it. He called attention to the short life of certain organisms and the long life of others, especially those producing spores.

This communication was discussed by Dr. L. O. HOWARD and Mrs. E. M. ENLOWS.

The second paper was by Dr. L. STEJNEGER: *The amphisbaenoid lizards and their geographic distribution.* Dr. Stejneger called attention to various theories that have been advanced to account for the distribution of animals, and explained how the amphisbaenoid lizards, with their peculiar morphology and habits, were particularly adapted to show former connections with now separated land masses and islands. The distribution and relationships of these lizards clearly showed a former land connection between South America and Africa.

Dr. Stejneger's paper was illustrated by charts, diagrams, and maps showing the classification, the structural taxonomic characters, the probable evolution, and the geographic distribution of the amphisbaenoid lizards. The Chair, Dr. L. O. HOWARD, Dr. C. H. T. TOWNSEND, Gen. T. E. WILCOX, and others took part in the discussion.

The last paper of the evening was by W. L. MCATEE: *Sketch of the natural history of the District of Columbia.* Mr. McAtee gave a very interest historical account of the study of the natural history of the District of Columbia from the earliest accounts of Capt. John Smith

who ascended the Potomac River as far as Little Falls and made notes on the fauna of the region, and the accounts of other early explorers and travellers, down to recent times. The speaker gave many entertaining quotations from the writings of these early naturalists, told about the early societies interested in the natural history of the District, and described the faunal and floral lists that have appeared, mentioning the number of species in each and calling attention to the fact that the District of Columbia is the type locality for many species.

Mr. McAtee's communication was discussed by the Chair, and by Messrs. L. O. HOWARD, D. E. LANTZ, and WILLIAM PALMER.

M. W. LYON, JR., *Recording Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the 496th meeting, held March 7, 1916, Dr. C. L. G. ANDERSON read a paper on *Old Panama.* After reviewing the voyage of Columbus along the Panamanian coast and incidents of the early history of the Isthmus, especially the settlement of Balboa, Pizarro, and others on the Gulf of Darien in 1510, he spoke particularly of early accounts of the aborigines. West of the colony of Darien came the Indian Province of Cueva, and west of that the province of Coiba, which ended at Limon Bay and the Chagres River. Darien or Cueva is a better name than Cuna for the Indians commonly known as San Blas, Mandingas, etc. These, of course, do not include the Chocos of Columbia. The natives of Urabá, east of the Gulf of Darien, were always called Caribes; they fought with bows and poisoned arrows. The Dariens, at the time of the Conquest, did not poison their weapons or make war with bows and arrows, but with wooden swords, long lances, and javelins hurled by the use of throwing sticks. Unlike the Mexicans and Peruvians, they had no belief as to the coming of the white Messiah, and fought the Spaniards from the start.

Oviedo mentions the following among the tongues between Urabá and Cape Gracias a Dios: Cueva, Coyba, Burica, Lengua de Paris, Lengua de Veragua, Chondales, Nicaragua, Chorotegas, Oroci, Orotiña, Güetares, and Maribios.

There were four kinds of houses: (1) quadrangular, (2) circular, (3) communal dwellings similar to those among the San Blas today, and (4) dwellings in the tops of trees. The first whites exaggerated the nudity of the natives, for pages are devoted to descriptions of their clothing. They possessed both ordinary and ceremonial garments. Females wore a short skirt and often added a shirt. Chiefs wore long white robes on ceremonial occasions. According to the same early chroniclers the tribes believed in a supreme being, and worshipped the sun, moon, and many spirits. They had medicine men and priests who told the people what they should do. Puberty was attended with ceremonies. There was much drinking of chicha at weddings and a house was built for the young man by his friends. After confinement a woman bathed herself and babe in the river and the newborn was

fumigated with tobacco. When not warring, the bands bartered dry fish, sea-salt, shells, pottery, etc., among themselves. Slaves were branded or had a particular tooth pulled out. Graves were covered level with the ground, although the Chibchas constructed burial mounds. The bodies of chiefs were desiccated over a slow fire. All undertakings began with drink, singing and dancing.

The best recent description of the Chocos is by Mr. H. Pittier. There is much discussion over the classification of the Indians of western Panama. A memorial of 1606 A. D. mentions among the tongues in Chiriqui Province those of the Cothos, Borisques, Dorasques, Utelaes, Bugabaes, Zunes, and others. The Bureau of American Ethnology was urged to study the Isthmian tribes before their primitive customs are lost.

Mr. PITTIER said, in discussing the paper, that it had been determined that Columbus was at Limon, and that the blowpipe, as well as the bow and arrow, was used by certain tribes of the region. Dr. ANDERSON agreed that Panama Indians used the bow and arrow to some extent, but stated that they were not employed in warfare. Following Mr. PITTIER's statement concerning slaves farther north, Dr. SWANTON pointed out that there was no true slavery in North America north of Mexico, excepting on the North Pacific Coast. The so-called slaves of the Pawnee or the Green Bay tribes mentioned by others were nothing more than war captives.

At its 497th meeting, held March 21, 1916, Miss FRANCES DENSMORE, of the Bureau of American Ethnology, addressed the society on *Mandan Music*. The songs and legends presented by the speaker were collected among the Mandan Indians on the Fort Berthold Reservation, in North Dakota, during two visits to that reservation, the first in 1912, the second in 1915.

A few facts concerning the history of the tribe were given by way of introduction. The Mandan are of Siouan stock and first appear on the page of history in 1738. About ten years later they are said to have been living near the mouth of the Heart River, in North Dakota, and remains of their villages at that point were found by Lewis and Clark in 1804. An epidemic of smallpox almost obliterated the tribe in 1837, the number of survivors being estimated at about 125. Lewis and Clark give the number of Mandan previous to this epidemic as 1600. Since that time the tribe has increased and the report of the Indian Office for 1914 gives the number of full-blood Mandan as 220. Some of these are sturdy old people who have kept their tribal traditions, and from such men and women the material comprised in this paper was collected.

To the minds of the Mandan their country was peopled with spirit beings who lived in the trees and the buttes. From the spirit women who lived in Eagle Nose Butte, about 30 miles south of the present site of Bismarck, they say they received a society called the Creek Women Society, with its ceremonial songs. Some details concerning

this society were given by the speaker, who also outlined the legend of the Terrible Snake who lived in Thunder Butte.

After describing briefly the life in the old Mandan village the speaker passed to the principal subject of the paper, which was the custom of eagle catching. The tradition of the origin of this custom, as well as of the wolverine fetish owned by every leader of the eagle catchers, had been secured from the last Mandan who owns such a fetish and has the inherited right to sing the songs connected with it. These songs comprised those taught to the first eagle catcher by a wolverine, and include songs given to the wolverine by the buffalo, black eagle, coyote, and snake, as well as songs to be sung when the eagle trap was constructed and the bait prepared, the cord for securing the eagle made ready, and the sweat lodge built in the eagle camp. Other songs were connected with eagle catching, which was an undertaking having a deep significance and a somewhat ceremonial character. Several of these songs were sung by the speaker, who also gave a song said to have been learned from the Moon. A song connected with the legend of the origin of the flute was given in connection with the narrative.

Charts were presented giving a comparison of Chippewa, Sioux, and Mandan-Hidatsa songs, as studied by the speaker. In these diagrams were included certain songs of the Hidatsa, who for many years have lived in the same villages with the Mandan, and other songs which cannot be accredited with exactness to either tribe. The musical material obtained on this reservation is therefore considered as Mandan-Hidatsa when placed in comparison with that of other tribes. Comparison of tonality with Chippewa and Sioux shows the Mandan to contain a larger percentage of major songs than either of these tribes, the percentages of major songs being 57 among the Chippewa, 40 among the Sioux, and 65 among the Mandan-Hidatsa. Comparison of structure showed the percentage of harmonic songs (those whose contiguous accented tones bear a simple chord-relation to each other) to be 24 per cent among the Chippewa, 12 per cent among the Sioux, and 35 per cent among the Mandan-Hidatsa. These comparisons are based upon the analysis of 70 Mandan-Hidatsa songs, while the number of Chippewa and Sioux songs examined is much larger. Further investigation may somewhat change the results of the comparative analysis.

The paper was illustrated throughout by lantern slides, and was followed by two musical numbers under the direction of Mr. HEINRICH HAMMER, showing the adaptation of Indian themes in musical composition. One of these was a fantasie for violin and piano, composed by Mr. Hammer on a theme collected by Miss Densmore and presented for the first time on this occasion.

At the 498th meeting, held April 4, 1916, Miss ADELA C. BRETON, Fellow of the Royal Anthropological Institute, read a paper on *Australasian museums and their work*. The natives are becoming absorbed

into the white community and in many places are semicivilized and losing their former crafts. Nowhere except in the museums can the ethnologist get a thorough understanding of what they accomplished. The Australian Museum at Sydney has immense series of all Australian weapons, arborglyphs, etc., and a magnificent New Guinea collection, including pottery, and bone daggers. Among American things are Arkansas pottery; Peruvian figure pots, throwing sticks, and celts with lance heads; and shell beads from Yucatan (received from A. Bastian). The bone daggers are like those in the ear piercing ceremony in the Mexican picture codices. They are said to be for dispatching an enemy and are usually made from the tibia of a cassowary. The Perth Museum collection includes native string knotted bags, stone implements of an early type, glass spear heads, spear throwers, bull roarers, and the only known spear head of pottery; also pottery from Zuni, Chiriqui, and Nicaragua, sent in exchange by the Smithsonian Institution; and ancient Patagonian arrow points, stone borers, incised pottery, etc. The serrated glass spear heads of Australia exhibit the highest skill and are still made for sale by natives imprisoned at Broome on the northern coast.

The Adelaide Museum has rare, rudely made native canoes, axes, quartzite daggers in sheaths, stone picks used for fighting at close quarters, and big stone axes a foot long; also native skulls, a Pacific Islands collection with models of houses, and metal bomerangs from India and West Africa. The unwieldy stone axes are very heavy and were set in short handles of pliant wood split for the stone to pass through and fastened with resin, as in the case of tomahawks. The Melbourne Library and Museum contains Australian ceremonial objects of painted wood and feather decorations somewhat similar to those of the Hopi, on which Baldwin Spencer is an authority; also petroglyphs, boomerangs, lillil (or waggera), shields, axes, and wedges. The Kenyon and Mahony collection has 10,000 stone implements, showing a great variety of types from different places. At Portland, paleolithic types were found; on the Gouldbourne, chipped river pebbles; in the interior, where brittle stone implements were scarce, they were used and re-used to make pigmy types. The Hobart Museum has the skeleton of the last Tasmanian. This state, like the others, prepared interesting handbooks that contained much information about the natives for the British Association for the Advancement of Science, which met in Australia in 1914. The Auckland Museum of New Zealand has much Maori ornamentation. An entire house has been re-erected in the great hall, the interior walls finely carved in panels. Still finer are some panels and long pieces of carved wood from an old house that was taken down and the carved parts buried for safety during a war. Small wooden coffins shaped like fetishes and painted are shown and there is a skeleton and the unfinished stone axes buried with it. There are many carved ceremonial clubs, and all show evidence of a high state of art formerly prevailing among the Maori.

Dr. R. W. SHUFELDT (a member of the Royal Society of Melbourne), Drs. SWANTON, MICHELSON, and FOLKMAR, and others took part in the discussion. Special mention was made of a skull, probably pleistocene, recently discovered in the Darling Downs, this being the oldest of human remains so far found in Australia. Many photographs brought from Australia were shown by Miss BRETON, including views of a settlement of aborigines 40 miles from Melbourne; also arrow heads and other artifacts. Miss Breton also read printed and manuscript accounts of the natives as seen about 1830 by her father, a naval officer, who considered the Australians the lowest race he had met in any part of the world.

DANIEL FOLKMAR, *Secretary.*

At the 499th regular and 37th annual meeting held April 18, 1916,, Dr. JOHN R. SWANTON, President of the Society, read a paper on *The influence of inheritance on human culture.* The speaker stated that he would apply the term heredity to the inalienable things which the individual receives in body and mind through ancestors, and the term inheritance to alienable ideas and things which have been transmitted to him by the entire social body into which he was born.

The environment which one inherits is of two kinds, the environment of unaffected nature and the environment which previous generations have brought into being by their action upon nature. The direct action of nature has been much dwelt upon and would appear at first sight fundamental, but, on inquiring what environment is, we find that all depends upon the amount of environment which a people is able to grasp. Thus the same area may include tribes of very different planes of development, and the culture of succeeding generations in the same area may be wide apart. The history of man exhibits a constantly greater grasp of environment by most peoples of the earth, a grasp which extends farther and farther into the past, owing to improved methods of recording, and brings humanity more and more in touch with the future. Speaking in economic terms this heaped-up wealth is the capital of humanity, with which more capital is created in the present, to be again transmitted. All of it is not, however, of social value. The ideas which come to us down the stream of time may be false and the institutions and other creations may be injurious. There is a conservative instinct which tends to preserve what is of no real utility, an instinct comparable in many ways with that biological conservatism which tends to preserve vestigial organs in animals. Many such elements seem to have resulted from the perversion of what was once of value, but others appear never to have had any excuse for being.

One of the most pernicious of all appears to be that which permits the ownership of a disproportionate share of world capital to limited or privileged classes. Monopoly in learning, however, has been gradually destroyed by the multiplication of books, journals, and other means of education, while monopoly in things still continues. We are

"the heirs of all the ages," but too many of us are younger sons, and the owners of privilege always endeavor to transmit to their blood or business descendants as much advantage as possible. One set of privileges consists in patents of nobility and governmental privileges attached thereto. Another is the ownership of some economic necessity, such as land, mineral or oil deposits, power sites, franchises involving control of means of communication or the furnishing of articles of general necessity or utility, the control of industrial establishments, and so on.

In connection with these various types of control it must not be forgotten that the value of each, as a money making proposition, depends without exception on society, because if society did not endorse privileges and purchase commodities there would be no value in ownership. To this must be added the service which society performs in defending and preserving the source of income. Such considerations limit very much our estimate of the service which even the most capable beneficiary of privilege performs; and when, under the action of our laws of inheritance, the source of income passes to another, the moral right of the heir, measured in terms of service, becomes much less. Nevertheless, it is possible that sources of income of the several kinds enumerated may descend indefinitely in particular strains of blood, and under such circumstances there appears to be little difference in position between those who enjoy titles of nobility and those who enjoy titles to industrial sources of income. The fact that control of income-yielding property may be ended by sale or bankruptcy does not alter the fact, so long as the *general* condition exists, any more than the banishment of a single nobleman and the confiscation of his possessions alters the fact of the existence of a titled nobility.

The ultimate solution of this question appears to involve one of two courses of action: either some method of binding together use and ownership so tightly that he who uses a thing will not be excluded from at least partial ownership in it, or ownership vested in the state or some other collective and immortal body, use being granted individuals during the limited period of their lives. The accumulations of human society, its capital, are primarily collective accomplishments and, therefore, society has a prior right to them. Whatever service the individual may perform, he cannot properly maintain a vicarious right to compensation after his death in the persons of his descendants or successors.

The following officers were elected for the ensuing year: *President*, Dr. JOHN R. SWANTON; *Vice-President*, Mr. WILLIAM H. BABCOCK; *Secretary*, Miss FRANCES DENSMORE; *Treasurer*, Mr. J. N. B. HEWITT; *Councillors*, Dr. TRUMAN MICHELSON, Mr. NEIL M. JUDD, Mr. FRANCIS LAFLESCHE, Dr. C. L. G. ANDERSON, and Dr. EDWIN L. MORGAN.

FRANCES DENSMORE, *Secretary*.

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